

From: [Brent Ranalli](#)
To: [Hernandez-Quinones, Samuel](#)
Cc: Jonathan.Koplos@cadmusgroup.com
Subject: RE: EP-C-12-023, WA 1-09 Report
Date: Thursday, January 09, 2014 9:35:58 AM
Attachments: [Task 2 preliminary risk calculations 1-9-14.docx](#)

Hi Sam,

Here is the draft, prepared by John Mauro and reviewed by Cadmus, of preliminary risks calculations for 90-day adult exposure to combined Sr-90 and Y-90 in drinking water at doses of 100 and 250 mrem.

We look forward to your comments. When you're satisfied, John and his staff are ready to proceed on the remaining assessments.

All the best,

Brent

Brent Ranalli
The Cadmus Group
617-673-7140

From: Jonathan Koplos
Sent: Wednesday, January 08, 2014 11:12 AM
To: Hernandez-Quinones, Samuel
Cc: Brent Ranalli
Subject: RE: EP-C-12-023, WA 1-09 Report

Hi Sam,

Happy New Year! I hope yours is starting off well.

A bit later today we'll send you a draft that presents the analyses from John/SC&A for the limited combination of assumptions you described below in your Dec 17 TD.

The note will come from Brent Ranalli, a colleague here at Cadmus, who works with me on your PAG project.

Thank you,

Jonathan

From: Hernandez-Quinones, Samuel [<mailto:Hernandez.Samuel@epa.gov>]
Sent: Tuesday, December 17, 2013 11:04 AM
To: Jonathan Koplos
Cc: Coleman, Ronald
Subject: EP-C-12-023, WA 1-09 Report

Hi Jonathan,

Under Task 2 of this Work Assignment. Go ahead and do the appropriate calculations and submit tables for the risk level associated with exposure to Radionuclides under the following scenarios. Before completing the whole set of Tables I would like you to submit as a Draft of the following combination of assumptions (90 day exposure, Adult, 100 & 250 mrem Dose). Once I review and provide any comment to you (if applicable) you can go ahead and finalize the assessment.

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- Use the dose and conversion parameters contained in FGR-13.
- Exposed Subpopulations shall include. Pregnant Women, Infants, Children, Adults, Elderly, Women of Child Bearing Age.

- Consumption factors for exposure at different ages for the requested subpopulation groups shall be taken from the EPA exposure factors handbook.
- Tables for exposure duration of 30, 60, 90, and 360 days.
- • Risk should be calculated for the following exposure scenarios: 4, 10, 15, 25, 100, 250, 300, 400, and 500 mrem/yr.

Thank You

Sam

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"USEPA Protecting Human Health and the Environment"

SR-90/Y-90 RISKS DUE TO THE INGESTION OF WATER BY AN ADULT OVER A 90 DAY PERIOD, ASSUMING AN EFFECTIVE WHOLE BODY DOSE OF 100 MREM AND 250 MREM

The first step in this calculation is to determine the Sr-90/Y-90 intake that results in an effective dose (e₅₀) of 100 mrem and 250 mrem to an adult (the values represent both male and female adults). Federal Guidance Report No. 13 (CD Supplement, Revised 2002) cites a Sr-90 dose conversion factor of 2.77E-8 Sv per Bq ingested and a Sr-90 mortality risk coefficient for an adult (25-70 years) of 1.02E-9 risk per Bq of water ingested. The mortality risk coefficient for Sr-90 includes the risk associated with Y-90 that forms from decay of Sr-90 in the body, but not the risk associated with the Y-90 present in the ingested water due to Sr-90 decay in the water source. With a half-life of 64 hours, Y-90 has dose and adult mortality risk conversion factors of 2.69E-9 Sv/Bq and 6.12E-11 per Bq, respectively. The dose coefficients and risk coefficients for ingested Sr-90 and ingested Y-90 must be summed.

The Sr-90/Y-90 intakes that result in an effective dose commitment of 100 mrem and 250 mrem are derived as follows:

$$\begin{aligned}(3.04\text{E-}8 \text{ Sv/Bq}) (X \text{ Bq}) (1\text{E}5 \text{ mrem/Sv}) &= 100 \text{ mrem} \\ (3.04\text{E-}8 \text{ Sv/Bq}) (Y \text{ Bq}) (1\text{E}5 \text{ mrem/Sv}) &= 250 \text{ mrem} \\ X &= 3.3\text{E}4 \text{ Bq} \\ Y &= 8.2\text{E}4 \text{ Bq}\end{aligned}$$

The second step is the derivation of the lifetime cancer mortality risk (R) associated with this intake, as follows:

$$\begin{aligned}R &= 3.3\text{E}4 \text{ Bq} \times 1.08\text{E-}9 \text{ Bq}^{-1} = 3.56\text{E-}5 \\ R &= 8.2\text{E}4 \text{ Bq} \times 1.08\text{E-}9 \text{ Bq}^{-1} = 8.86\text{E-}5\end{aligned}$$

This same approach can be used to derive total cancer risk (i.e., morbidity) by using the Sr-90 and Y-90 morbidity risk coefficients of 1.08E-9 Bq⁻¹ and 1.1E-10 Bq⁻¹ for water ingestion by an adult, as follows:

$$\begin{aligned}R &= 3.3\text{E}4 \text{ Bq} \times 1.19\text{E-}9 \text{ Bq}^{-1} = 3.93\text{E-}5 \\ R &= 8.2\text{E}4 \text{ Bq} \times 1.19\text{E-}9 \text{ Bq}^{-1} = 9.79\text{E-}5\end{aligned}$$

A table presenting these values can take the following form (Table 1):

Table 1. Adult Dose and Associated Mortality and Morbidity Risks Associated with Drinking Water Ingestion that Results in an Effective Dose Commitment of 100 and 250 mrem

50 Year Effective Dose Commitment (mrem)	Lifetime Mortality Risk	Lifetime Morbidity Risk
100	3.56E-5	3.93E-5
250	8.86E-5	9.79E-5

Risks can be readily derived in a similar manner for any age group and by gender using tables of dose and risk coefficients that are currently available in software developed by ICRP.

The dose associated with a particular risk level can be spread out over a longer or shorter time period. Derived intervention levels (DILs) can be calculated for any age group by dividing the radionuclide intake over a given time period (e.g., 90 days) by the appropriate volume of water ingested over that time period, as specified in the EPA Exposure Factors Handbook.